A Good Look at Greenhouses

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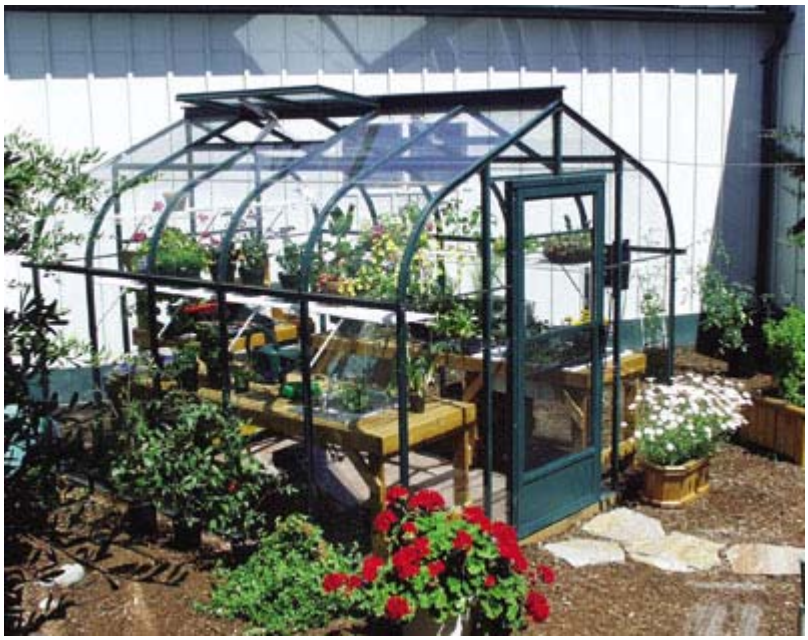


A greenhouse means the gardening season doesn't have to end with the onset of winter. It provides a light-friendly location for growing flowers, vegetables or other plants. Enjoy plump, juicy tomatoes in winter and decorate your home with tropical flowers throughout the year. A greenhouse can be built big or small, and designed to suit the casual hobbyist or serious gardener. Thanks to technological advances in building materials and available features, constructing a high-quality greenhouse doesn't necessarily require a lot of money or time. But careful planning is key before starting the project.

Location, Location, Location

First and foremost, decide on a proper location for the greenhouse. The whole point of a greenhouse is exposure to sunlight, so locate the building to maximize light exposure. Exposure to sunlight all day is ideal, but morning sunlight is usually sufficient for plants. Morning sunlight is most desirable because it initiates the plants' food-production process early in the day, maximizing growth. Also, consider what type of plants you intend to grow. Reproductive fruiting plants, such as tomatoes and cucumbers, require more heat, light and control than vegetative plants like herbs and lettuce.

If positioning the greenhouse near trees is unavoidable, try to locate the building so the greenhouse is shaded from the intense summer sun in late afternoon, but not shaded by the trees in the morning. Also, deciduous trees such as oak or maple will shed their leaves, allowing more exposure to the sun in winter. Evergreen trees, however, should be avoided because they will block the less intense winter sun.

If possible, locate the greenhouse where it will be exposed to at least 6 hours of direct sunlight during the winter months. The best orientation is to position the greenhouse with its length running east and west. This will provide more heat gain from the sun during the winter, when the sun is lower in the sky.

Proper drainage is another requirement for a good greenhouse site. When possible, construct the foundation above the surrounding ground so water will drain away.

Also consider the location's accessibility to sources of heat, water and electricity, as well as shelter from strong winds. Access to the greenhouse should be convenient for both people and utilities.

Size, Shape and Style

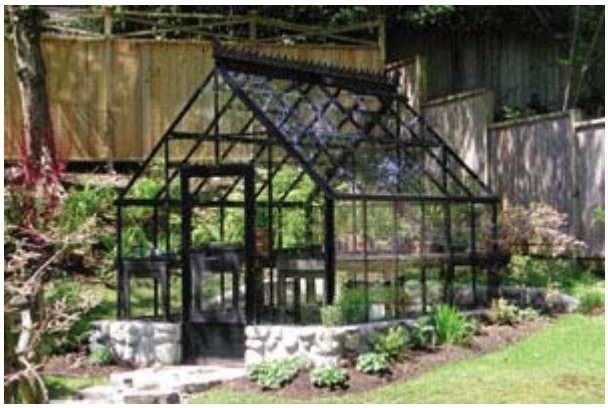
The design possibilities for a greenhouse are endless. When it comes to size, plan the interior layout on graph paper, accounting for the width, number and spacing of plant benches, as well as the walkways between them. Allow for storage space, and consider room for a small table and chair. First decide how much room you need to create your greenhouse, and then add more square footage to the plan. It is much easier and cheaper to account for future expansion at the beginning than to add the needed space later.

Cost is another factor in determining greenhouse size. A 24-by-48-foot structure might be nice, but heating and cooling a structure that size can significantly impact the pocketbook. Heating will likely be the biggest cost of operating a greenhouse. A smaller greenhouse or a lean-to style structure attached to the home might be a more cost-efficient move.

Greenhouses also vary greatly in type or style. A lean-to greenhouse is half a greenhouse, split along the peak of the roof and attached to the side of a house or other freestanding structure. Lean-to's are useful where space is limited to a width of about 7 to 12 feet, and they're the least expensive type to build.

An even-span greenhouse is a full-size structure, but has one gable end attached to another building. These are often large and costly, but generally offer more room and can be lengthened for future expansion.

Freestanding greenhouses are separate from other buildings and can be positioned for better exposure to sunlight. They can be as large or as small as the builder wants. However, separate heating, water and electrical systems may be required for a freestanding greenhouse.



Building Materials
A wide selection of frame kits and raw framing materials are available for greenhouses. They're commonly made of wood, aluminum or galvanized steel. Plastic frames are generally considered too weak to meet wind and snow-load requirements.

“I've seen some very nice home-built greenhouses,” says Charley Yaw of Charley's Greenhouse and Garden. “But they were a labor of love and took considerably longer to build than a kit. A home-built greenhouse can be a beautiful wooden structure that suits the nature of the site and its builder.” Charley's Greenhouse and Garden is a leading distributor of greenhouse kits, supplies and equipment. Charley notes that although wood is classically attractive, some of the ready-to-assemble kits on the market are considerably easier to maintain.

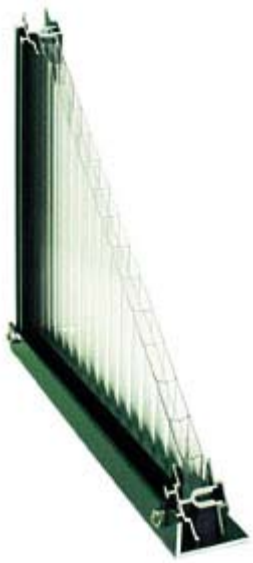
“Kits may be made of aluminum, which is maintenance-free, allowing the greenthumb artist to focus on growing plants rather than endless maintenance,” says Charley. “Remember, a greenhouse by design should create a humid atmosphere for plants. A greenhouse is a very difficult climate for wood, and needs to be maintained as much as you would a wooden boat. The greenhouse kit is quicker to build, and easier for a fast-paced lifestyle.”

Greenhouse frames can be covered, or “glazed,” with glass, fiberglass panels, plastic film or rigid multi-wall plastics:

- *Glass* – A traditional glass covering is attractive, inexpensive to maintain and can potentially last for years. Glass panels can create a weather-tight structure that minimizes heating and cooling costs. Tempered glass is often used because of its additional strength. The down side is that glass can break, is initially expensive to install and requires an extremely sturdy frame.
- *Corrugated* – Lightweight and durable, corrugated fiberglass is available in various translucent grades for greenhouse construction. The resin-coated fibers can last 10 to 15 years before needing a new coat. But once the resin begins to wear off, the exposed fibers can trap unsightly dirt. Corrugated polycarbonate panels are available in clear or translucent grades.
- *Plastic Film* – Flexible film made from a number of different materials are available in several different grades. These present the most inexpensive choice for a greenhouse covering. Building costs can also be lowered because the structural framing can be lighter. However, plastic film generally has to be replaced much more often than other covering materials. And, while light transmission is comparable to glass, plastic film tends to attract dust and will need periodic washing. Use only UV-stabilized film.
- *Multi-wall Plastic* – “The biggest change in greenhouse design has been the introduction of

insulated, lightweight, polycarbonate glazing panels to replace heavier tempered safety glass," says Charley. Companies such as Suntuf manufacture rigid multi-layer polycarbonate panels that offer a durable, moneysaving option for a greenhouse covering. The multiple walls of plastic, separated by webbing, significantly minimize heat transfer, which in turn saves on energy costs. Both acrylic and polycarbonate materials are typically available with 10-year warranties on their light transmission properties.

"Kits often come with 4.5-millimeter polycarbonate," notes Charley, "but I would recommend 6- or 8-millimeter, as it is stiffer and quieter on windy days. Triple-wall panels provide the best insulation."



Companies such as Suntuf manufacture multi-layer polycarbonate panels for greenhouse walls.

Floors and Foundations

Smaller greenhouses (100 square feet) can be supported by a single or double layer of treated 4-by-4 lumber. Most large greenhouses require poured concrete as a foundation. A permanent foundation must be constructed for any greenhouse over 200 square feet.

For a concrete foundation, remove plants and sod, then square and level the site. Cover the pour area with 2 inches of gravel. Place rebar in a grid pattern to strengthen the footing. Pour the concrete and let it cure. On top of the concrete foundation, use a treated 2-by-4 wood sill on which to anchor the greenhouse. Place 1⁄2-by-9-inch anchor bolts into the fresh concrete to fasten the sill, leaving only 11⁄2 inch above the concrete surface. Counter-sink nuts into the wood sill so the greenhouse base will not rest on the nuts. Set bolts within 1 foot of each corner, spacing additional anchor bolts about 4 feet apart.

A concrete foundation is recommended, but a concrete floor may not be a good idea. Water and soil can make a greenhouse floor a slippery, soupy mess. Instead, many greenhouse floors are covered by several inches of gravel to easily drain water from the structure. A 2- to 3-foot stone or paver walkway can be installed between benches for easy access to plants.

Environmental Control

The purpose of a greenhouse is to maintain an environment suitable for optimum plant growth. Although solar energy can provide some light and heat, a fully functioning environmental system requires regulating temperatures with heaters, fans and other equipment.

Heating – The heating requirements for a greenhouse depend greatly on the temperature required for the plants grown, which can vary among plant varieties. While the sun may provide a partial heat source, plant health depends on exposure to proper temperatures day or night, summer or winter. Size and insulation of the greenhouse will also impact what type of heating system will work best. In some cases, a 220-volt electric heater may suffice. Small gas or oil-burning heaters may also do the trick. Make sure your heating system offers adequate capacity for your greenhouse. Heating systems can be fueled by gas, oil, wood or electricity, and the heat can be distributed by forced air, radiant heat, steam or hot water. Unvented propane- or kerosene-fueled heaters are not recommended.
Circulation – Circulating fans can mix the air of a greenhouse so that warm air doesn't rise to the top, while cool air settles to the floor. Installing these fans ensures the heat is evenly distributed.
Ventilation – The exchange of interior air for exterior air helps to control temperature, remove moisture and replenish carbon dioxide levels. Natural ventilation uses roof vents with louvered side inlets. The rising heat escapes from the roof vents, which in turn pulls cooler air into the side inlets. Mechanical ventilation uses a motorized fan to exhaust air through one end of the greenhouse, while taking in air from an inlet on the other end. If relying on an exhaust fan, make sure it offers the capacity to exchange the total volume of air in the greenhouse every 1 1⁄2 minutes.
Cooling – In some cases, ventilation alone may not sufficiently reduce temperatures in a greenhouse. Temperatures may need to be lowered using shade materials, such as vinyl netting. “Place woven shade screen on the outside, as it is 40 percent less effective when placed inside the greenhouse,” suggests Charley, who recommends using a UV-stabilized shade material. “Polyethylene and polypropylene knitted screens are inexpensive. And a fiberglass screen makes a great material for a roll-up shade.”

Hanging bubble wrap on the greenhouse walls can help to insulate plants from the outside elements.

SIDE NOTE
Greenhouse Heat Requirements
The following formula can be used to determine the approximate heating requirements of your greenhouse:

A x D x 1.1 = Btu's. “A” is the total wall and roof surface area of your greenhouse. “D” is the difference between the coldest outdoor winter temperature and the night temperature desired in your greenhouse. “Btu's” is the heat requirement. Subtract 30 percent if the greenhouse is insulated using double glazing or a polyethylene liner. Subtract another 30 percent if it is a lean-to greenhouse on a heated wall.

– Source: Charley's Greenhouse & Garden

Watering Systems
When it comes to plant health, watering is essential. Hand watering may suffice if you're available during the day. But if you work away from home, a separate, automatic drip water supply will help maintain the

plants' water regimen. Systems that spray a fine mist can create humidity and provide water to plant seedlings. Time clocks or mechanical sensors can be used to automatically control many watering systems.

In fact, automated control devices can be used to control not only the water system, but cooling, heating and ventilation systems as well.

Greenhouse Automation
Many greenhouse hobbyists work day jobs and aren't always available to tend to their plants when needed. An automated system to control heating, water, ventilation and more would be ideal. Many of these systems are very expensive and more appropriate for the commercial grower. However, there are some affordable products on the market to help your operation, such as solar-powered vent controls.

Solar-powered vent openers are thermal pistons. A temperature-sensitive wax expands with heat, which drives a leveraged arm to lift the vent. As the temperature is lowered, the wax cools and shrinks. Gravity and “helper” springs close the vent and reset the piston. Opening and closing are gradual adjustments that allow just the right amount of airflow for cooling. Vent controls can lift up to 35 pounds each; combine two for a 70-pound lift.

Greenhouse automation can also be facilitated by a home computer. “There is computer hardware and software under $1,000 that allows monitoring your greenhouse from inside your home,” says Charley. “The Sensaphone will even call you on your cell phone and explain in a synthesized voice when the greenhouse climate is exceeding preset limits.”


Solar-powered vent controls help automate the vetilation system.

A Lot to Consider
The options abound with greenhouse construction, which is why careful planning is absolutely crucial. “Almost everyone wishes they had built the greenhouse bigger by about 50 percent,” says Charley, “including me.” He points out a few other common errors people make when building their first greenhouse:

• Inadequate ventilation
• No shading
• Poorly built foundation

- Failure to read the kit instructions before beginning to build
- Cutting or altering kit parts due to not correctly reading the instructions.

So plan ahead to avoid these mistakes. And research the many features and designs available for greenhouse construction. Whether building from a kit or starting from scratch, there is a lot to contend with. But with a little work and ingenuity, you can create the ideal greenhouse for many years of growing and gardening.

Doing It Yourself? Are you interested in *FREE* detailed plans on how to build your own greenhouse? Just visit the SUNTUF website at www.suntuf.com and click on the "Do It Yourself" link at the top of the page to access the plans in PDF format.

Editor's Note: *Special thanks to Charley Yaw of Charley's Greenhouse and Garden for help with this article. Additional information is from West Virginia University (www.wvu.edu). To learn more about building and using greenhouses, call Charley's help line open 7 days a week at 800-322-4707. Or visit Charley's online at www.charleysgreenhouse.com.*

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